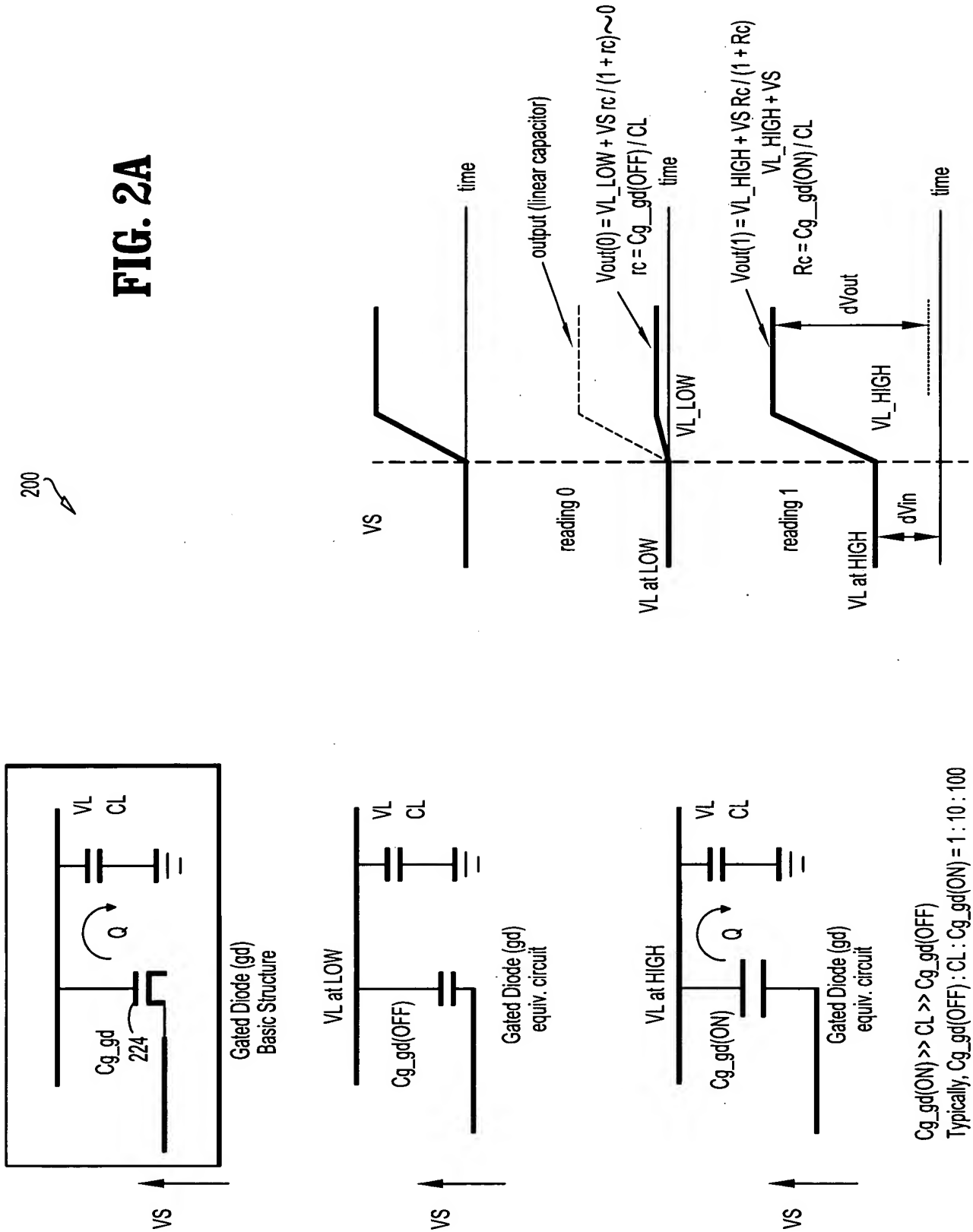


**FIG. 1A**





210

$$R_c = C_{g\_gd} / C_{g\_rg}$$

$$\text{Gain} = V_{g\_f} / V_{g\_i}$$

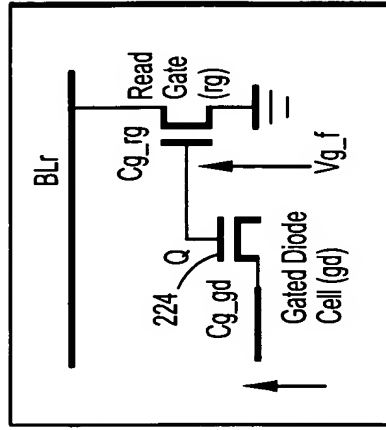
$$\text{Gain} = 1 + R_c - (V_{t\_gd} / V_{g\_i}) R_c \sim 1 + R_c$$

$$\text{Gain} = (1 + V_s / V_{g\_i}) R_c / (1 + R_c)$$

$$V_{g\_i} = 0.4 \text{ V}, V_{t\_gd} = 0$$

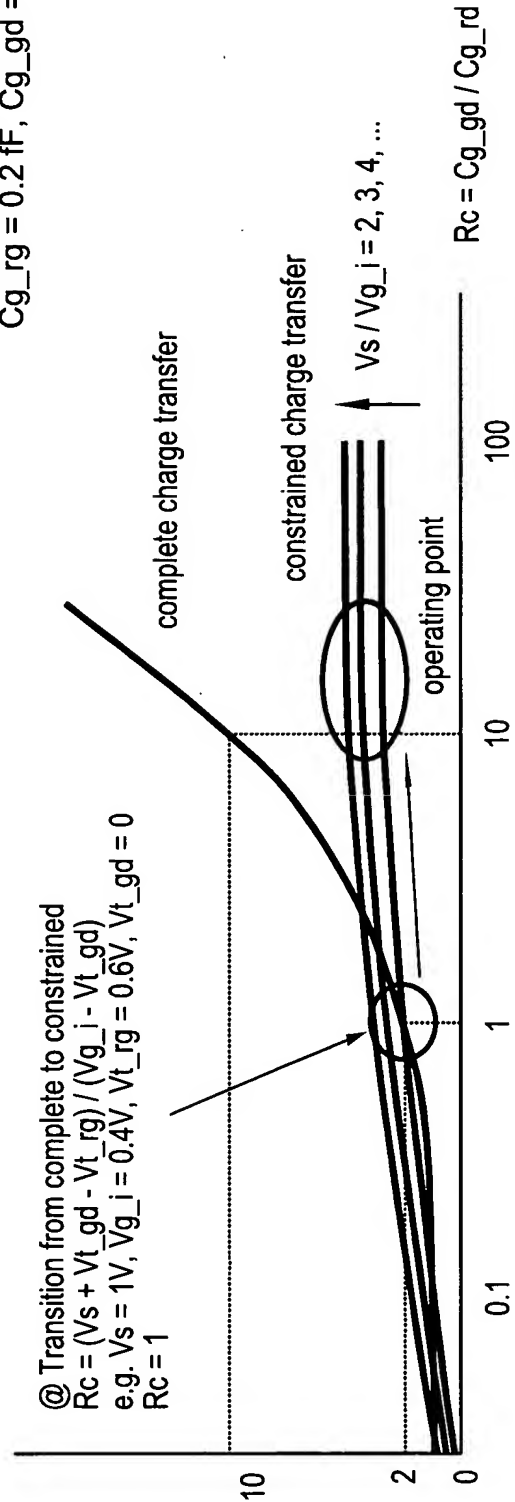
$C_{g\_gd} / C_{g\_rg}$	0.01	0.1	1	2	5	10	100	
$1 + R_c$	1.01	1.1	2	3	6	11	101	
$R_c / (1 + R_c)$	0.01	0.09	0.5	0.67	0.83	0.91	0.99	
Gain	0.35	0.32	1.75	2.35	2.91	3.19	3.47	$V_s / V_{g\_i} = 2.5$
Gain	0.04	0.36	2.00	2.68	3.32	3.64	3.96	$V_s / V_{g\_i} = 3$
Charge Transfer	<---	complete	---	<---	constrained	---	>-->	

typical operating point



@ Typical operating point  
-700 mV overdrive for Read Gate  
( $V_{t\_rg} = 0.6 \text{ V}$ )  
-10 - 20 x  $Q_{min}$  charge reserved in  
Gate Diode for SER protection  
 $C_{g\_rg} = 0.2 \text{ fF}$ ,  $C_{g\_gd} = 2 + \text{fF}$

$$\text{Gain} = V_{g\_f} / V_{g\_i}$$



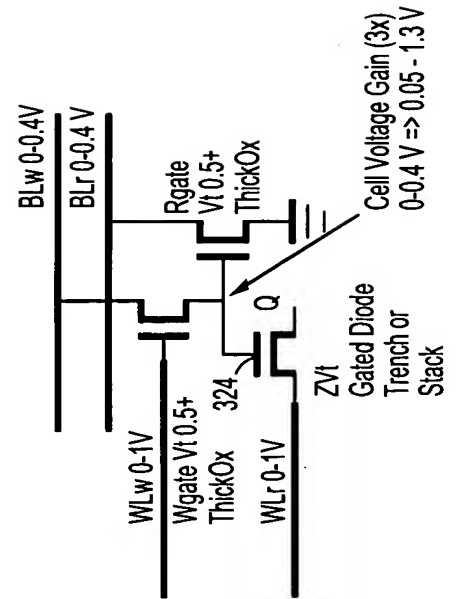
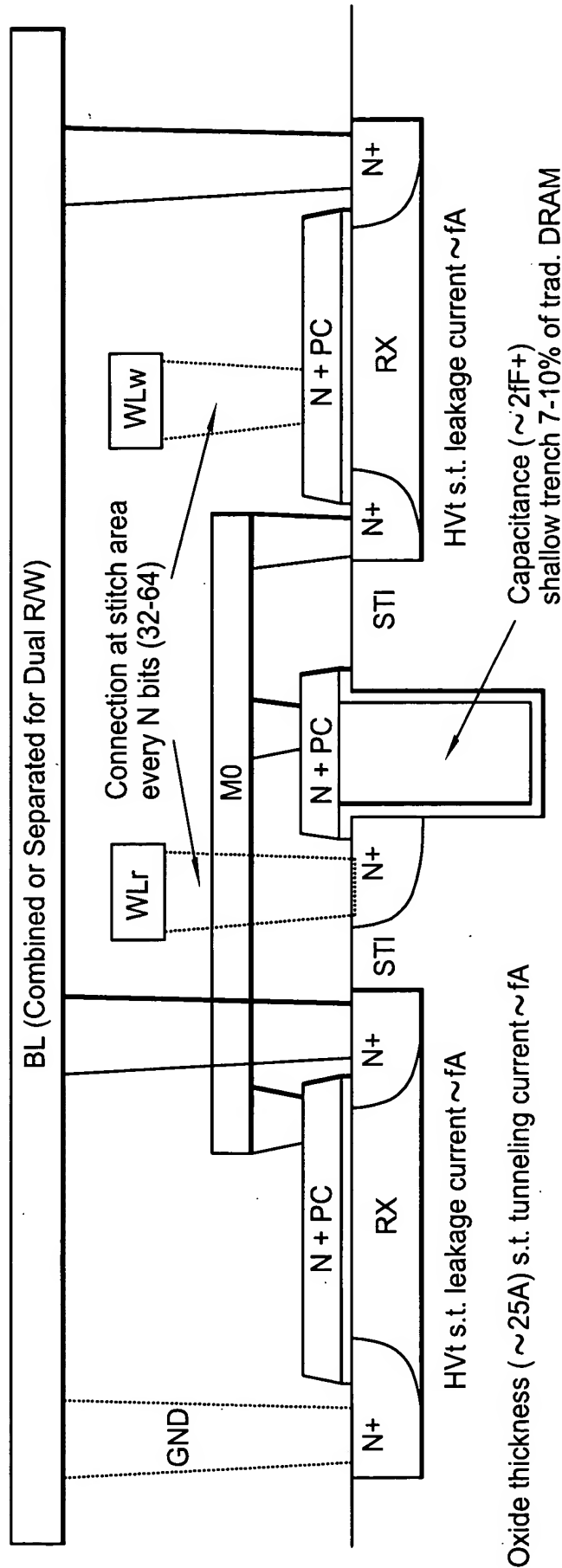
@ Transition from complete to constrained  
 $R_c = (V_s + V_{t\_gd} - V_{t\_rg}) / (V_{g\_i} - V_{t\_gd})$   
e.g.  $V_s = 1 \text{ V}$ ,  $V_{g\_i} = 0.4 \text{ V}$ ,  $V_{t\_rg} = 0.6 \text{ V}$ ,  $V_{t\_gd} = 0$   
 $R_c = 1$

FIG. 2B



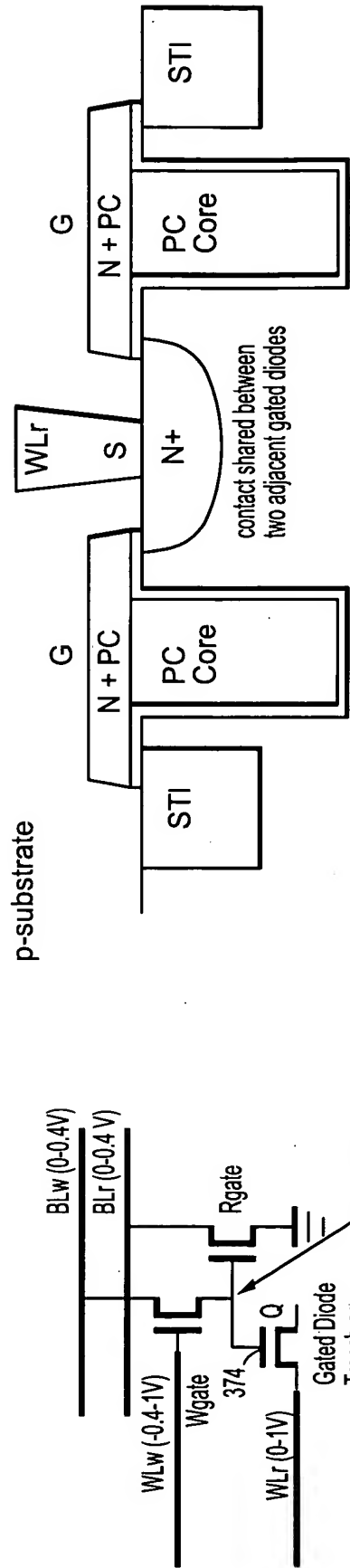
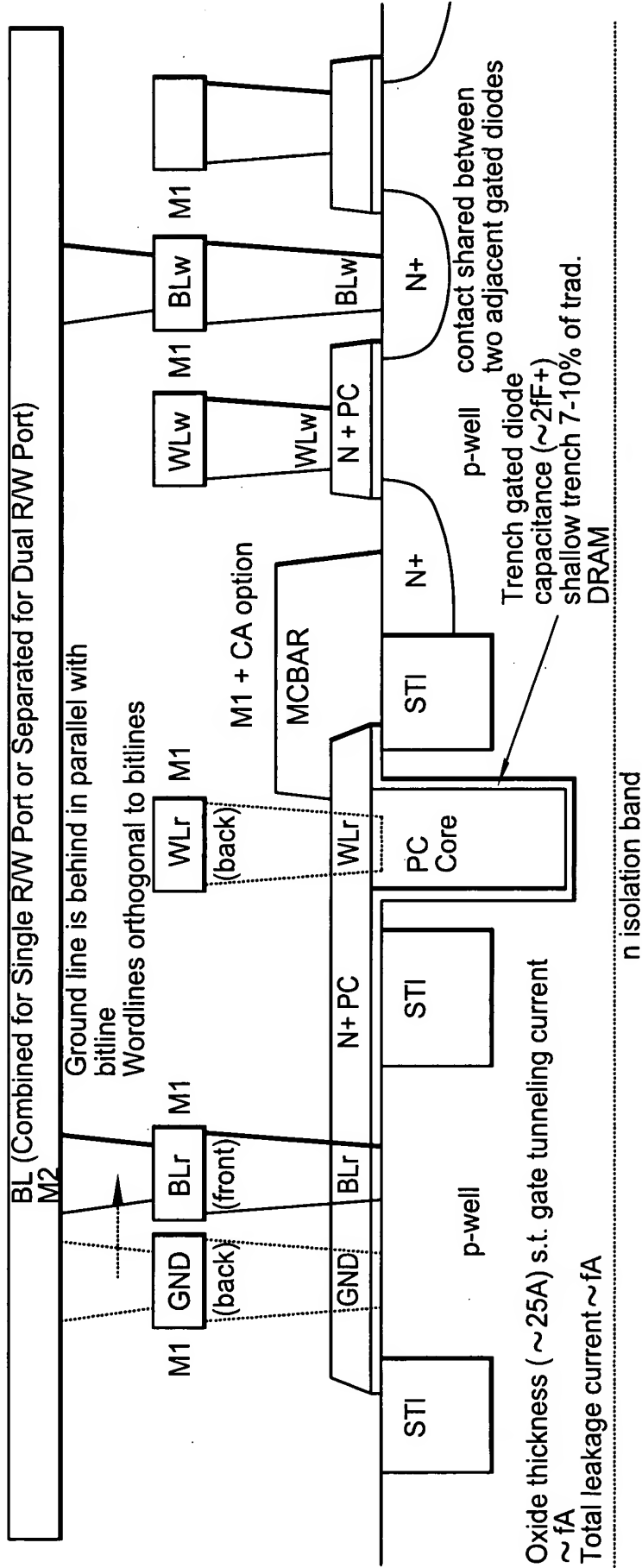
**FIG. 2C**

300

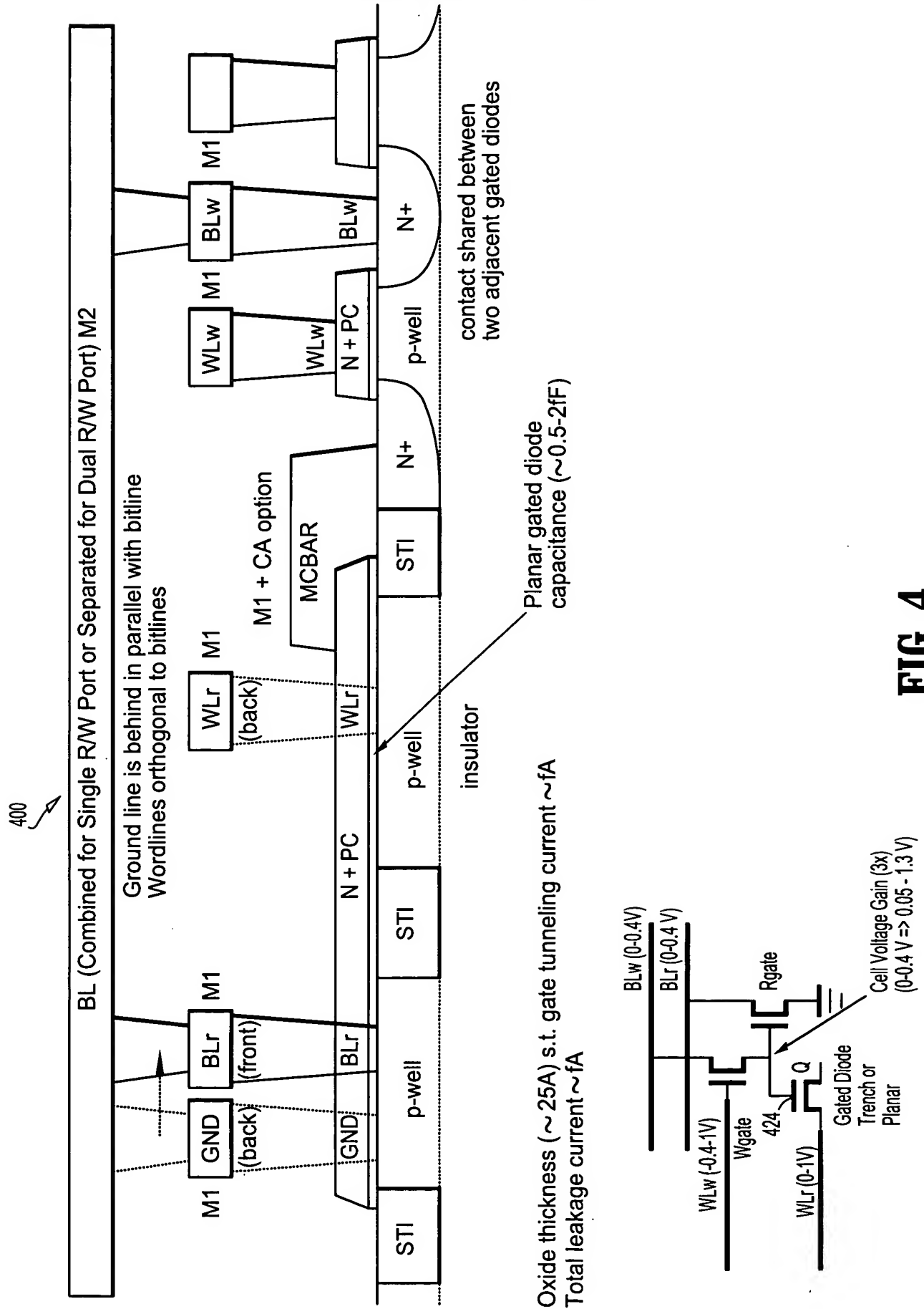


**FIG. 3A**

350

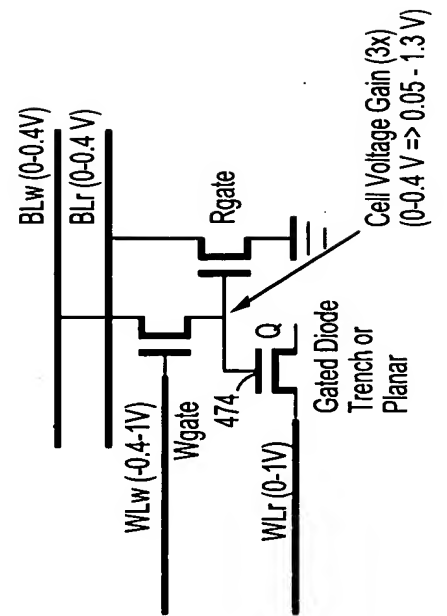
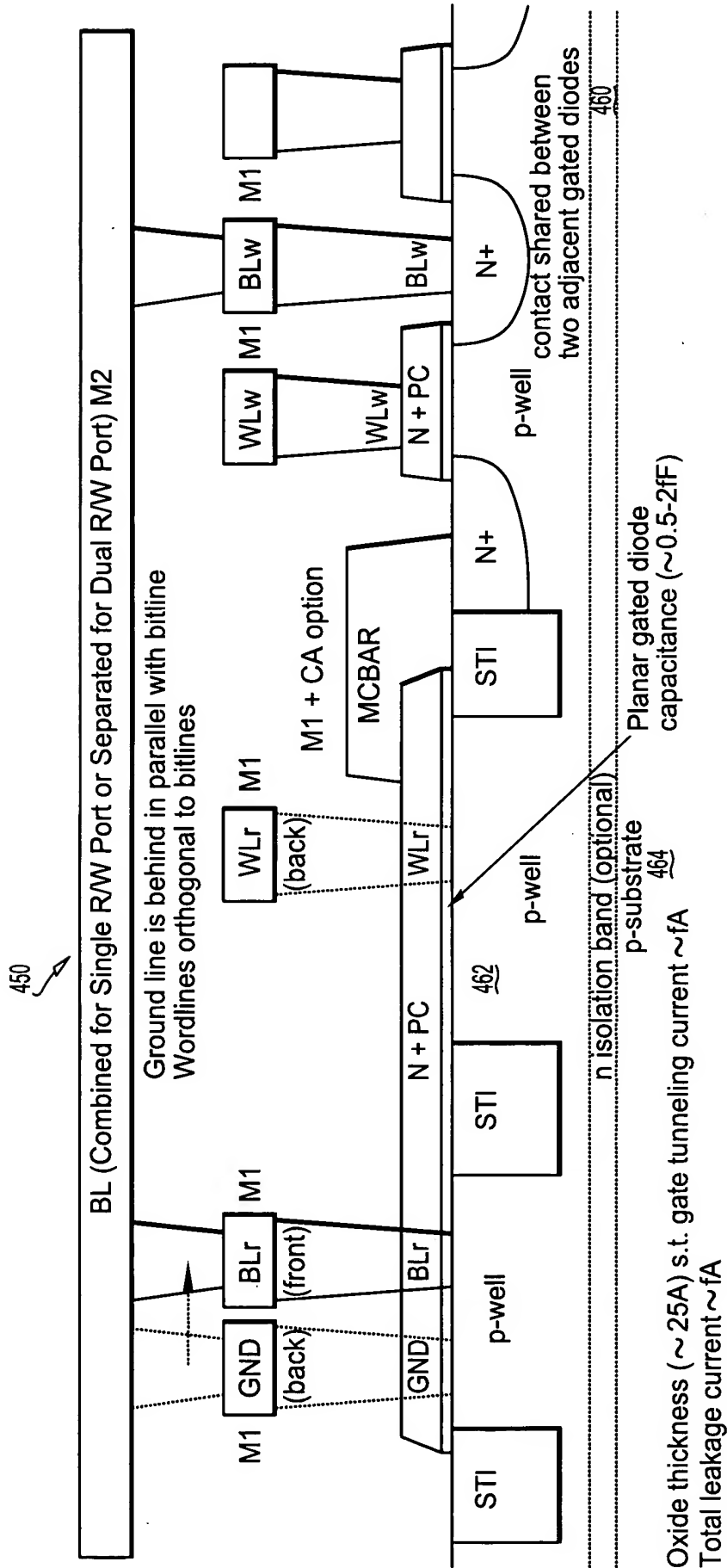


**FIG. 3B**  
Trench gated diode structure side cross-section

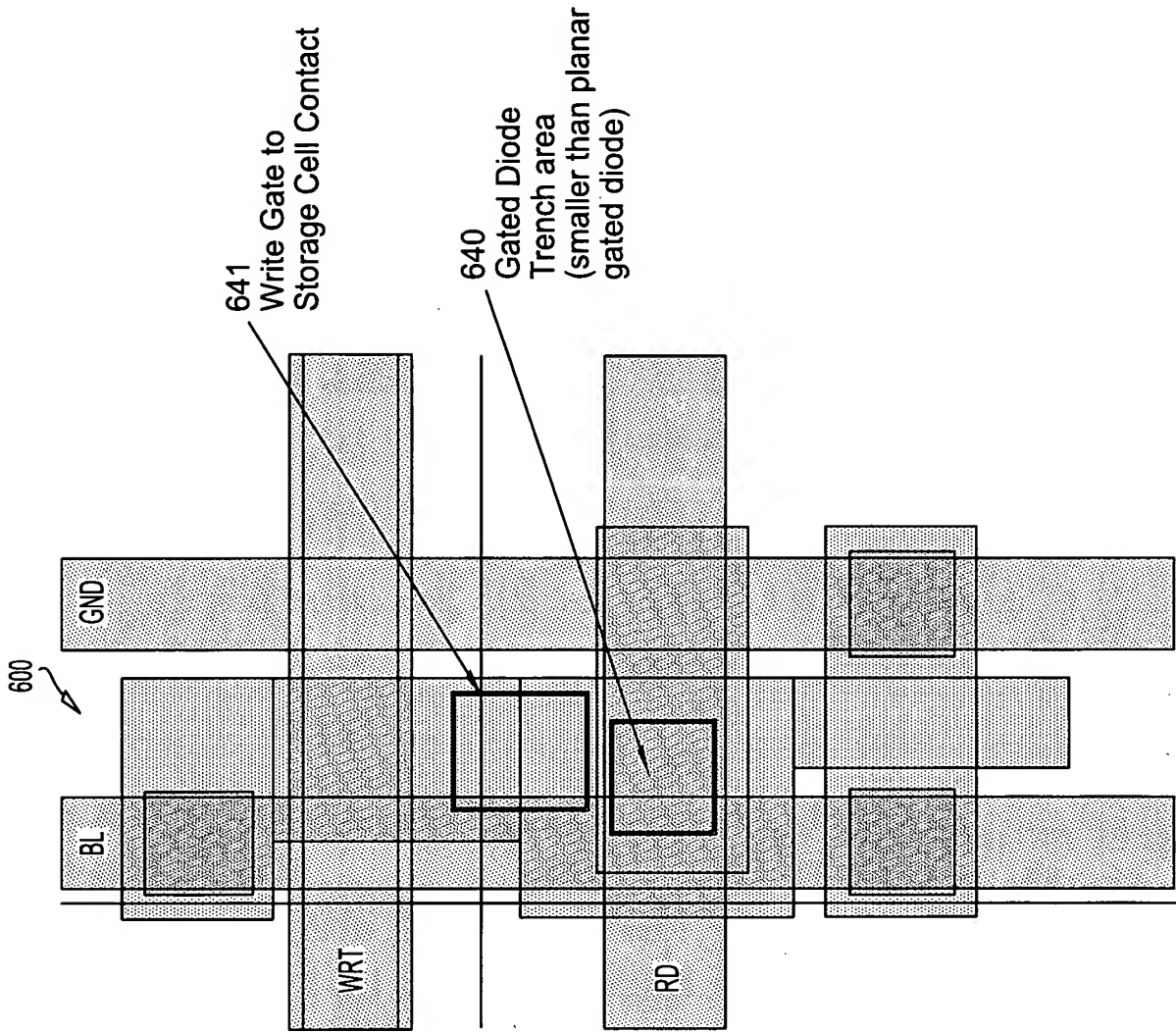


**FIG. 4**

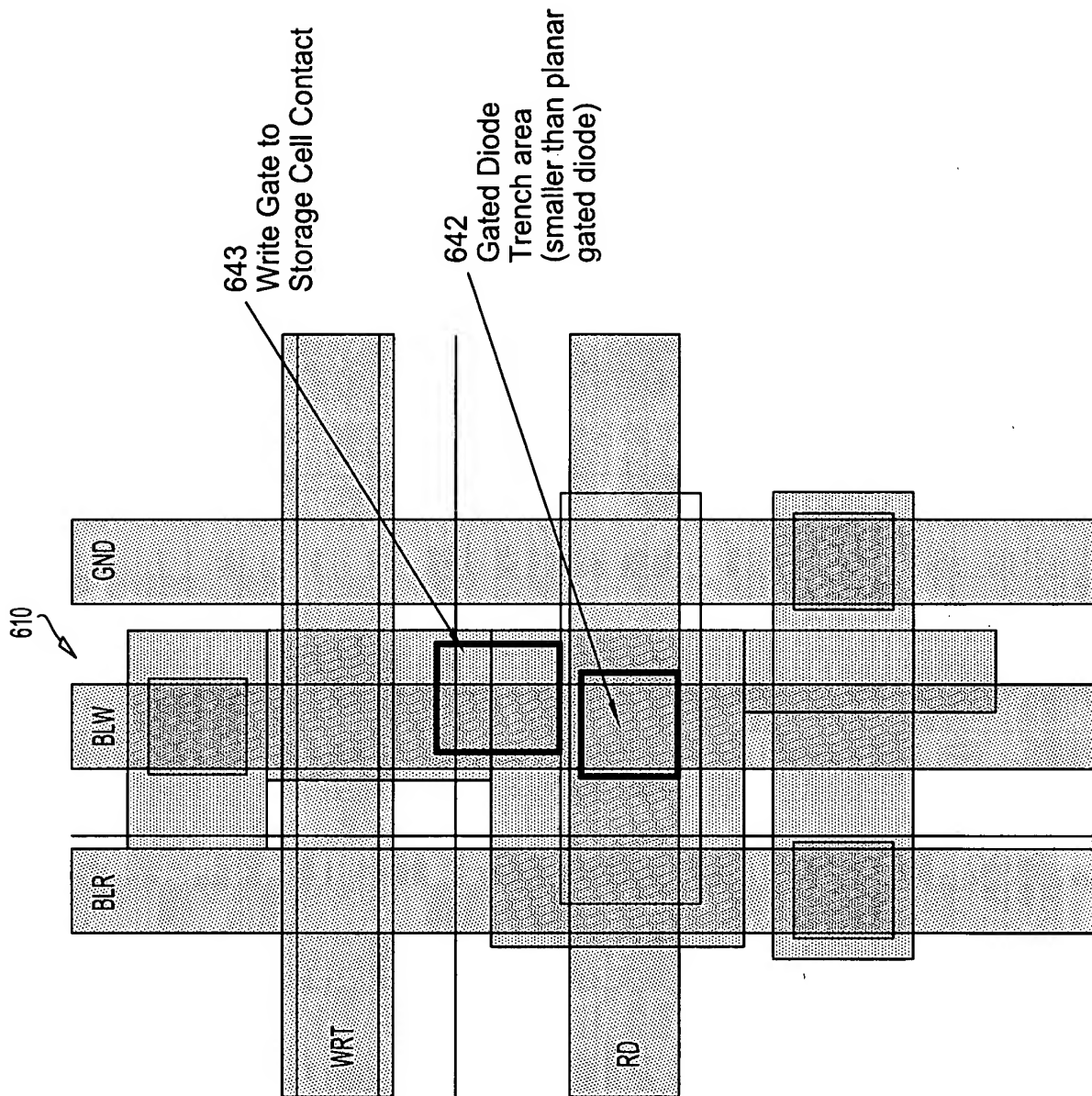




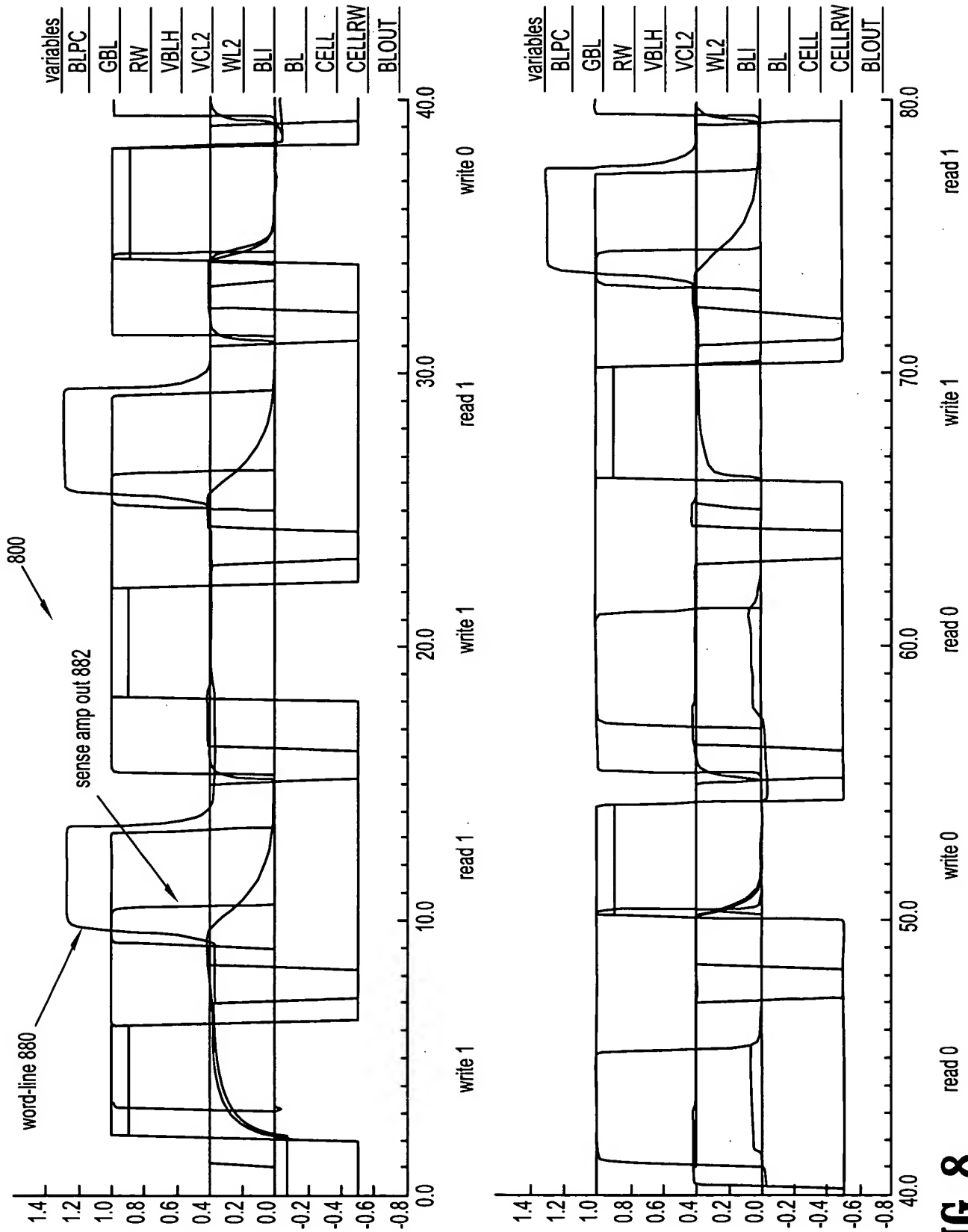
**FIG. 5**



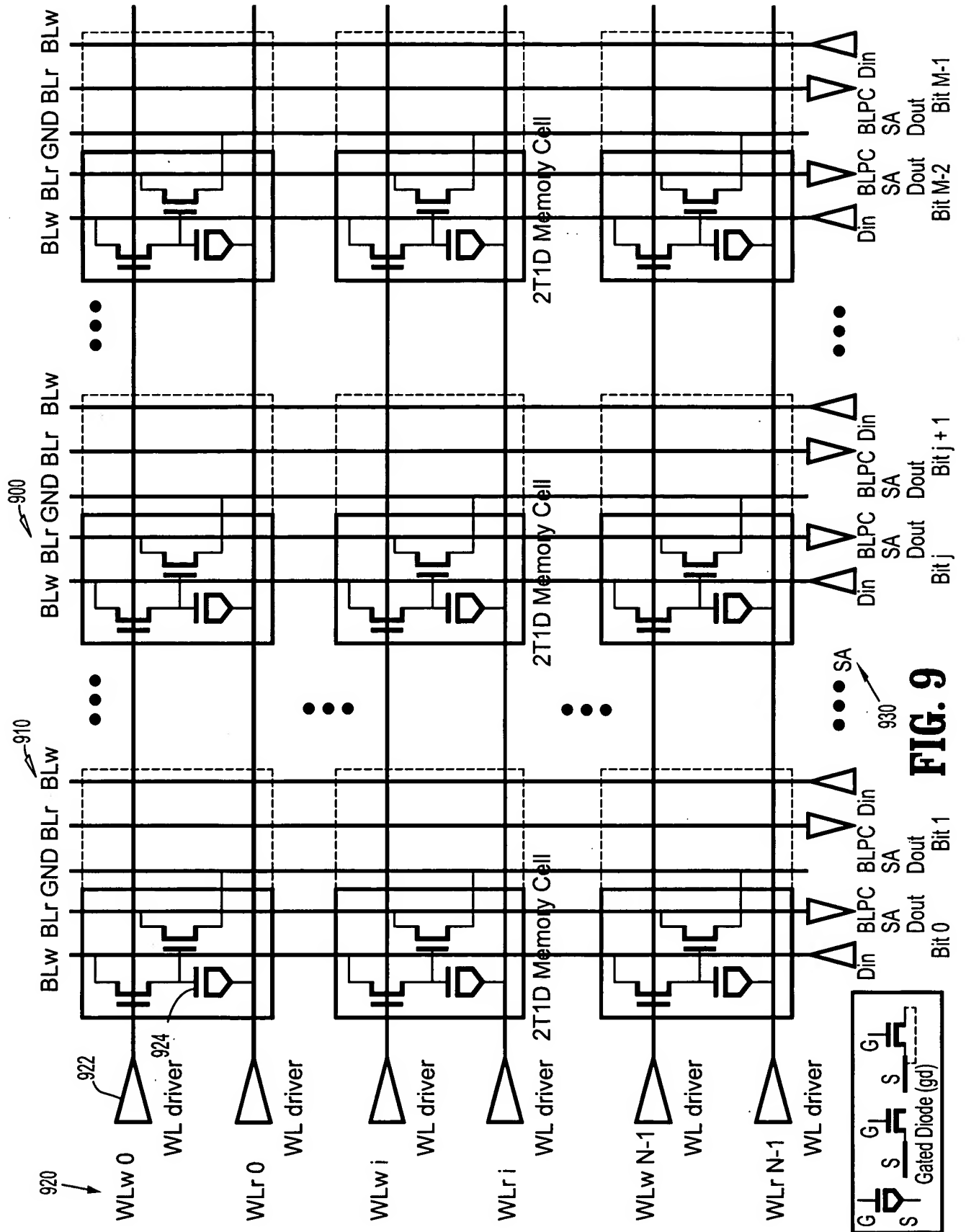
**FIG. 6**



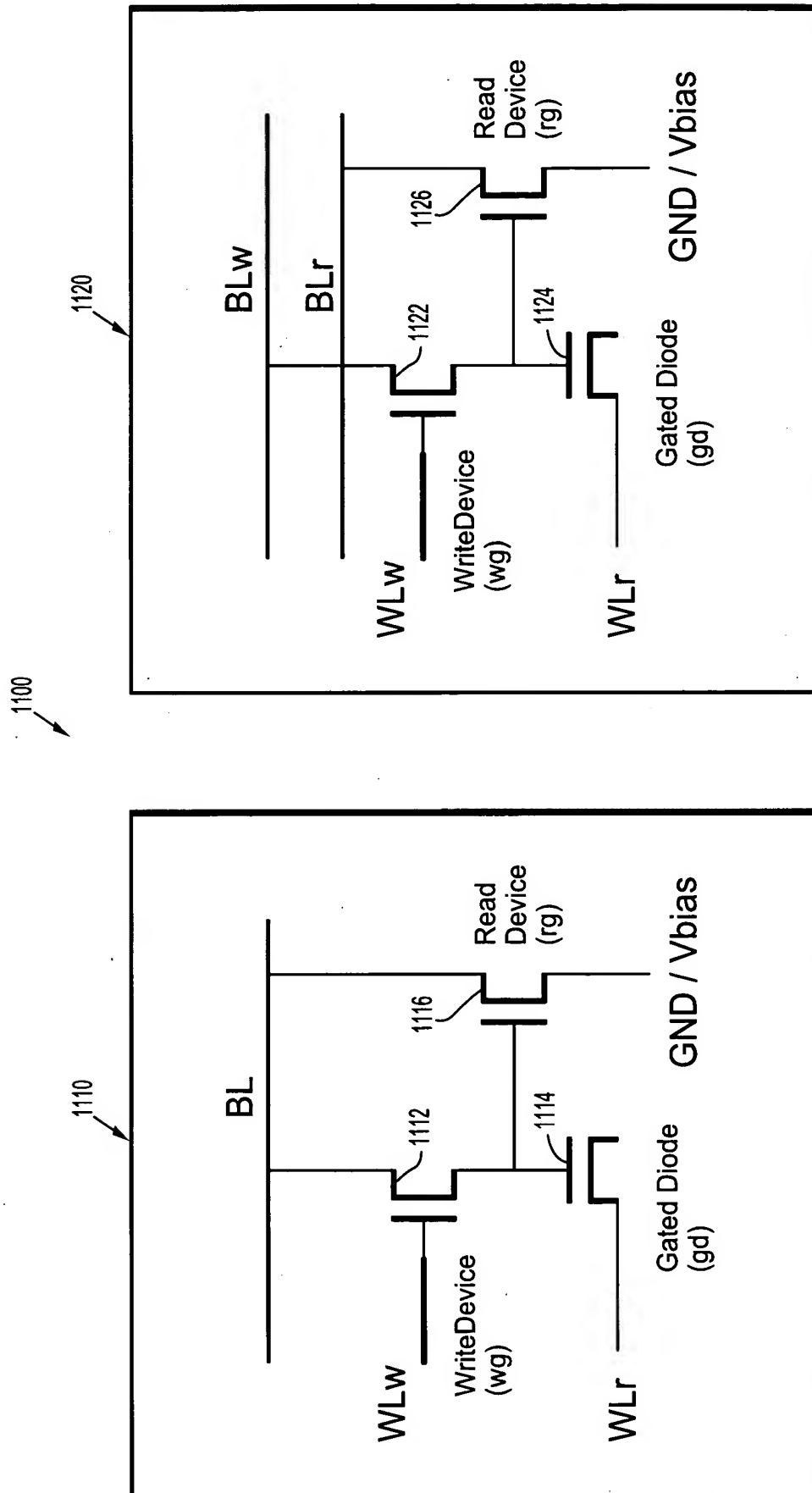
**FIG. 7**



**FIG. 8**



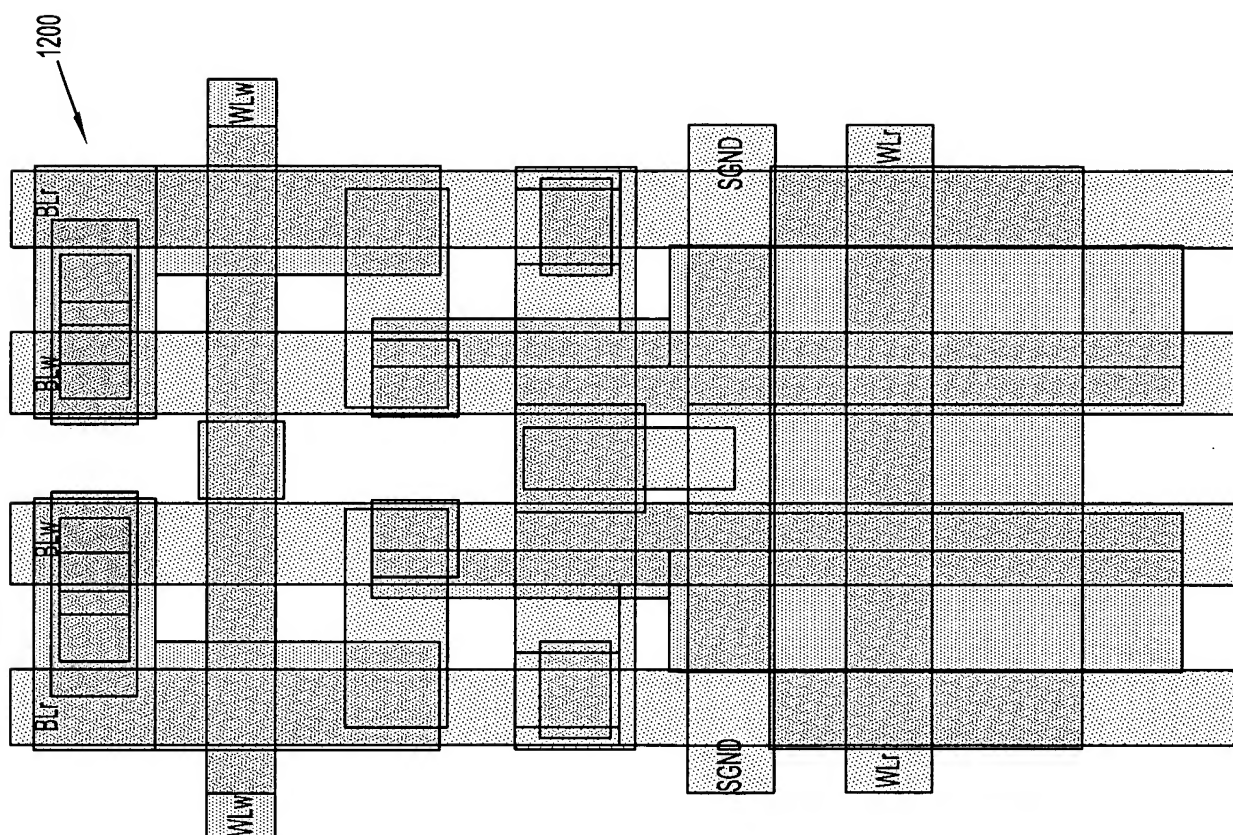




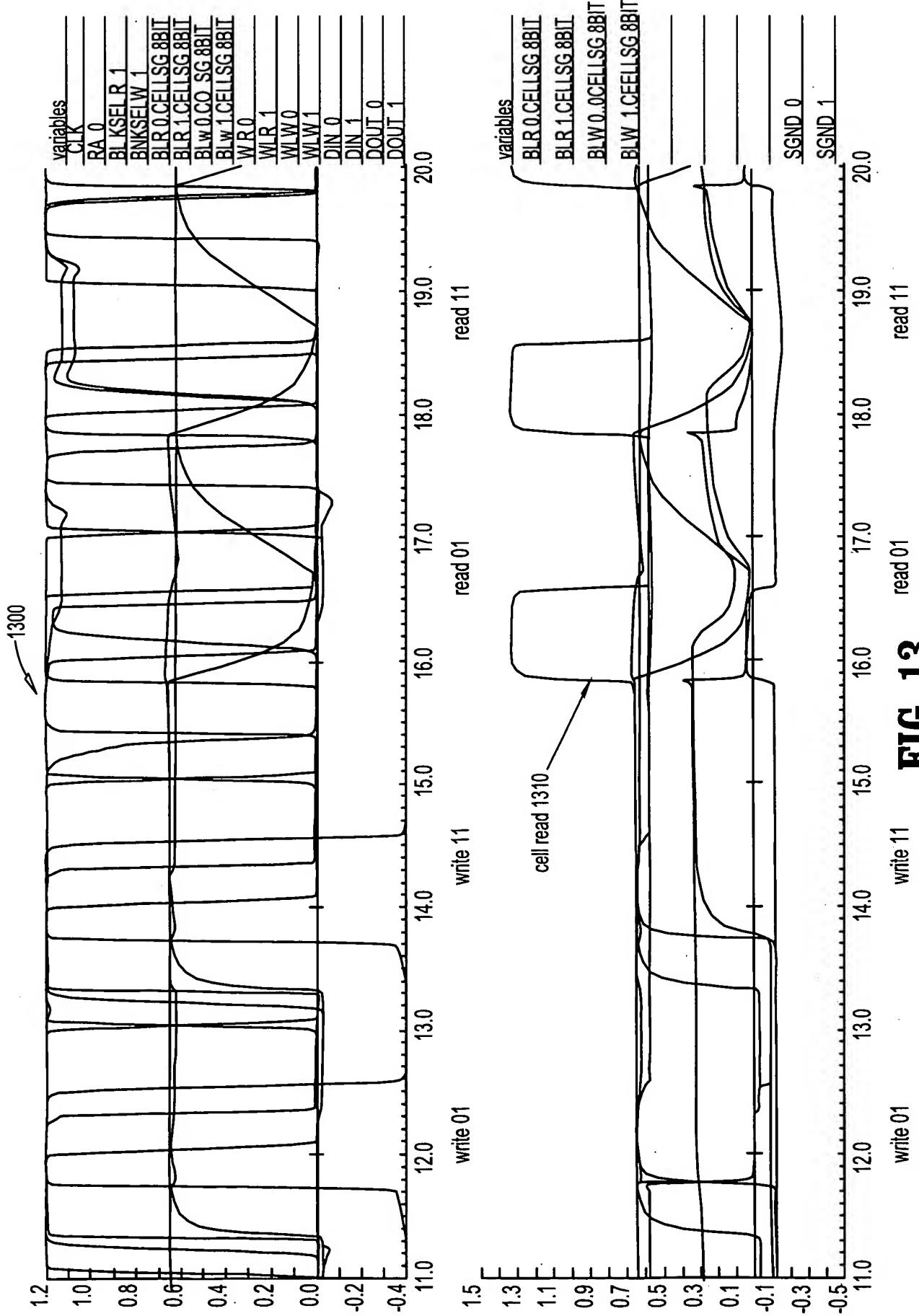
**FIG. 11A**



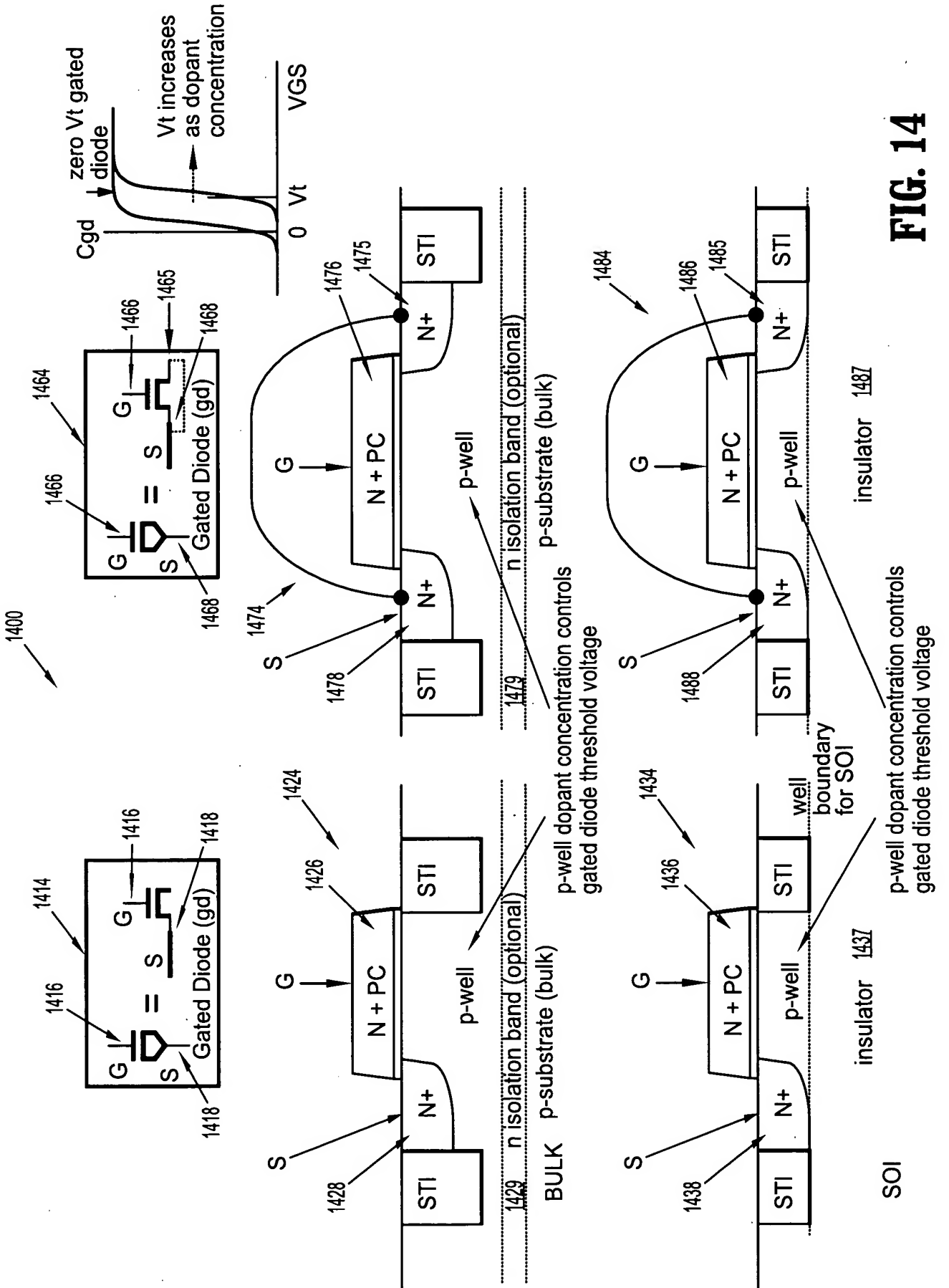




**FIG. 12**



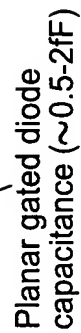
**FIG. 13**



**FIG. 14**



**FIG. 15**



**FIG. 16**

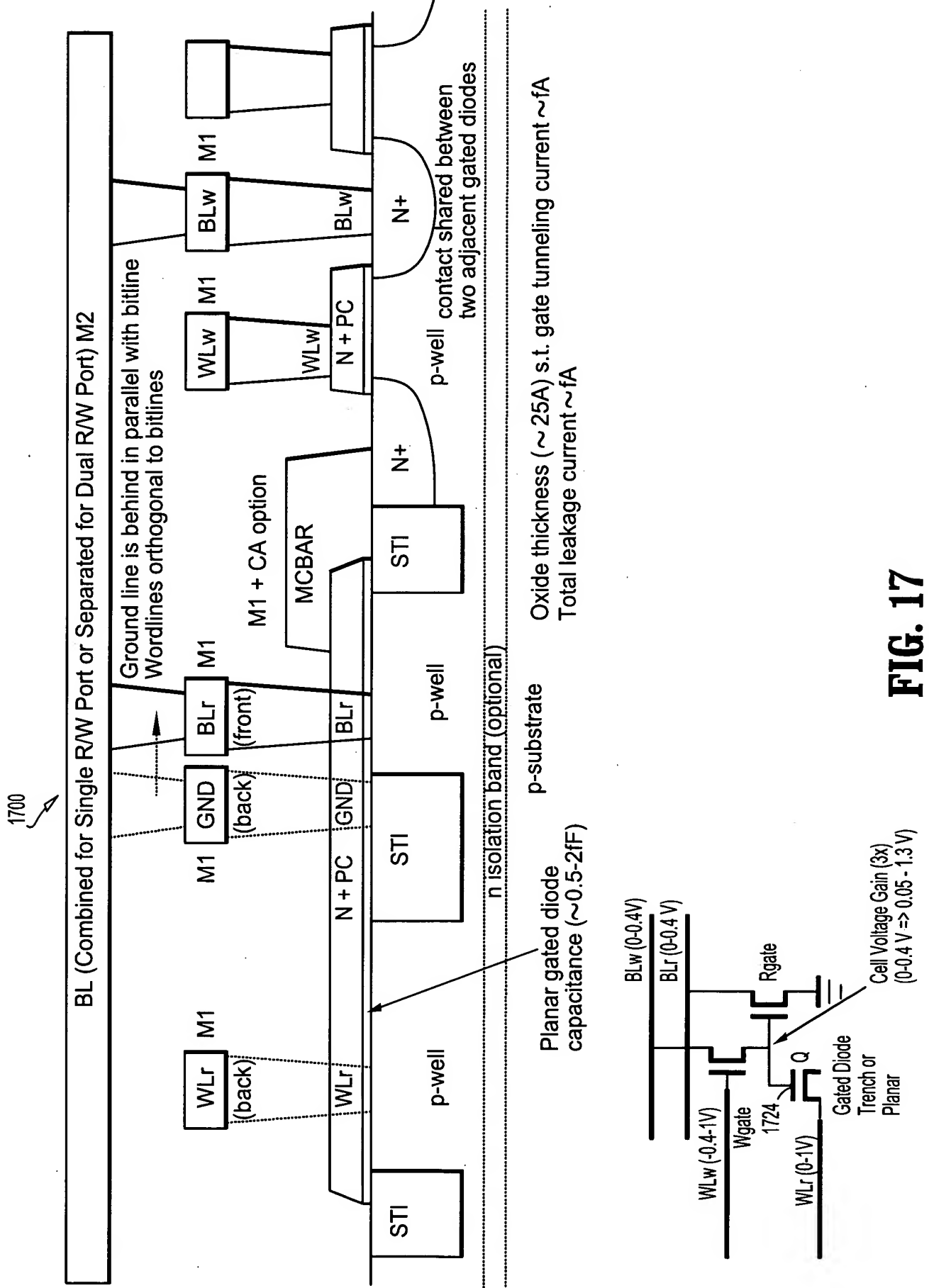


FIG. 17